Psychological Bulletin
1975, Vol. 82, No. 5, 802–814

Factors and Factors of Personality

J. P. Guilford
University of Southern California

An effort was made to account for the diverse sets of factors of personality found by the analysis of questionnaire items as reported by different investigators and to see what common ground there might be. Divergencies were attributed to certain insufficiencies in factor analysis and to the fundamental views of analysts with regard to emphasis upon data or upon personality theory. Some reconciliations were found by recognizing that factors of different levels of psychological generality can come out in a one-level analysis. A three-level model of factor traits, based upon 13 Guilford factors, was proposed as a frame of reference. Construct validities of factor traits from different sources were examined. Suggestions were made concerning how to deal with factors of different levels.

As this was being written, 40 years had elapsed since the first factor-analytic attempt to isolate dimensions of personality (Guilford & Guilford, 1934). The possibility for this approach had been suggested 4 years earlier (Guilford & Braly, 1930). After all these years, there is today a highly confused situation with regard to what the "real" factors are. In this article, I deal only with nonaptitude traits and with measurement only by means of questionnaire items.

We find that Cattell (1972) and Eysenck (Eysenck & Eysenck, 1969) claimed two very different sets of factors and piled evidence on evidence in attempts to gain support. Both claimed their factors are superior to those of others. On the other hand, Howarth and Browne (1971b, 1972) presented evidence that both Cattell and Eysenck factors are questionable. The situation is illustrated in a statement made by Eysenck and Eysenck (1969) after analyzing Cattell, Eysenck, and Guilford items together: "Eysenck factors are replicated reasonably well, the Guilford ones only partially, and the Cattell ones hardly at all" (p. 193).

I try to clarify this confused situation, to bring some degree of order and coherence into the factorial picture, and to account for some of the conflicting assertions and conclusions. There is no intention here to present a thorough review of an area of research; therefore, references must be selective. In the process of achieving the stated aims, I present my own views of the situation making much use of a new model of a relevant portion of personality, based upon Guilford factors, as a frame of reference. It is also necessary to make some general statements about the nature of factor analysis in order to explain why results are so often divergent.

THINGS TO BE REMEMBERED ABOUT FACTOR ANALYSIS

Limitations to Factor Analysis

In spite of all the negative appearances that factor analysis may give to the critical investigator, I am prepared to reiterate that the method can be a powerful tool to aid in deriving useful psychological constructs. But it cannot do so without theoretical psychological thinking to go with it. There has been entirely too much blind faith, on the part of many who factor analyze, in what factor analysis can do. I sometimes think that its chief value is to enable us to turn data around so we can look at them, from which new insights may arise. But more than that, it can be used to test those insights in a kind of hypothetico–deductive manner. Admittedly, this may not be in a way some investigators would demand. Fortunately, other ways of testing the validity of factorial constructs are available by more ordinary experimental methods.

Requests for reprints should be sent to J. P. Guilford, P.O. Box 1288, Beverly Hills, California 90213.

It is probably commonly known that the most disturbing deficiency of factor analysis is its indeterminacy—the lack of any completely dependable criterion as to where to place the reference axes. Thurstone's goal of simple structure is a useful guide, but it is by no means fully dependable. Several different rotations can satisfy his loose specifications. And when mathematical specifications for simple structure are written in the form of analytical rotation models (e.g., varimax or promax), the model may not fit psychological reality. Particular data can be fitted to it, but data may depart materially from the generalized picture that we want. We need to apply here the distinction between phenotypes and genotypes.

Only under ideal conditions will full isomorphism be found between data and psychological structure, and conditions are very rarely close to ideal. For one thing, those ideal conditions involve a good selection of variables, such as test scores, to be analyzed together. There must be a favorable pattern or combination of experimental variables. Each factor must be equally well represented in terms of the number of variables per factor, and each set must be equally strong with respect to the amount of variance. These requirements for selection are important because in connection with rotations of axes, there is a general principle that strong (better represented) factors tend to rob weak ones of their variances. A typical varimax rotational solution, for example, shows the effects of this principle. There are usually one or two very broad factors, with undue numbers of somewhat heterogeneous variables loaded significantly on them. Then there are a number of other factors of narrow scope, with very few variables loaded on them.

Too often the problem of the selection of variables most appropriate for analysis is ignored or given little attention. Thurstone repeatedly warned us on this point. Too often just any available pools of tests are selected, without reference to any hypothesis or theory. I do agree that factor analysis has a place in exploratory studies, in new domains, in which hypotheses are not very obvious. Cattell (1945) expressed himself in favor of the exploratory use of factor analysis when he said, "It becomes desirable and necessary to use factor analysis not so much as a check on hypotheses as an independent method of arriving at hypotheses" (p. 77). My own inclination is to get into the hypothesis-testing stage as soon as possible. Perhaps at this much later date, Cattell would agree.

The trend of this discussion suggests a hiatus between the orientations of psychologists who factor analyze. The focus seems to be either in the direction of data or of psychological constructs, for the empirical versus the theoretical analyst. The empiricist is likely to take the data structure to be the psychological structure. The theorist looks to the data to *suggest* the psychological structure, recognizing that the two may lack complete isomorphism. The theorist also requires replications with invariance of psychological factors, under somewhat varied conditions, with variations in samples of tests as well as in tested populations. He may also be concerned about relations among factors and possibly about superstructures. "Push-button" factor analysis has not yet achieved a foolproof program for grinding out invariant, generalized constructs under varied conditions.

Why Factor Analysts Disagree

Selection of variables. In what has just been said, we see some basis for the fact that two analysts might come out with different factors. More specifically, one reason is that they start with different pools of variables, which in the case of personality factors have usually been questionnaire items. Cattell (1945) started with a pool that was rather different from those of other investigators. Trying to cover the entire "personality sphere," it was natural that he should go beyond the item pools of analysts with more limited aims. Eysenck started with items representing Guilford factors, and it will be seen that there is much in common between his resulting factors and those of Guilford.

Another reason for divergence is that from the same pool of variables, different samples are drawn. This condition may result in the complete loss of certain factors in some analyses because they are underrepresented or not represented at all.

Number of factors extracted and rotated. To be seriously considered is the number of factors derived from a given set of variables. A good example of what can happen is found in an analysis by Jernigan and Demaree (1971). From intercorrelations of 300 items, they extracted 20 factors but rotated only 12 in one solution and 14 in another. All that were assumed to be meaningful were 10 in the first case and 12 in the second. Only 5 factors were considered to be in good agreement in the two solutions. We are left with the problem of deciding which, if either, solution is the "correct" one. A number of mathematical criteria have been proposed for deciding how many "real" factors exist in an analysis, but they often give different answers, and none can be recommended as dependable.

Rotation problems. As is probably well known, the question of how to rotate axes in factor analysis has been one of the most burning issues. As implied earlier, the major aim of the analyst makes some difference—whether his goal is to achieve psychologically meaningful constructs or to fit some mathematical model with data. The two aims are of course not mutually exclusive, for many aim at the latter with expectations of achieving the former. But, also as implied before, the fitting of the mathematical model may leave us with an unsatisfactory psychological picture.

One of the perennial issues concerns the alternatives of orthogonal versus oblique rotations. Somehow, I have never become excited about this issue. I reiterate the view that the same meaningful factors are likely to be recognized after either kind of rotation. Some supporting instances can be cited. Eysenck and Eysenck (1969) asserted that they found "no difficulty in" aligning orthogonal with oblique factors that are derived from the same intercorrelations. The same items are loaded significantly on the same factors. Jernigan and Demaree (1971), after analyzing 300 items by both varimax and promax methods, concluded that factor loadings were very much the same in the two solutions. After analyzing Cattell's items, Howarth and Browne (1971b) reported that oblique factors were very close to orthogonal ones. It must be admitted that with other data, there are probably instances in which two such solutions would be farther apart.

Thurstone first suggested oblique rotations as a means of achieving better simple structure, and this they will definitely do. The freeing of factor axes from the restraints of right-angle separations makes this possible. The number of zero loadings is increased or, as more commonly stated by analysts, more test vectors are brought into hyperplanes. Hyperplane count has become one of the most respected specific goals of analysts who are concerned with the mathematical picture. But to expect the solution with maximum hyperplane count to achieve the best psychological solution is wishful thinking.

Another payoff of oblique rotations has been the method it makes possible for investigating higher order factors. The angles of separation of the primary axes, which represent the first-order factors, give estimates of correlations between these factors. Such intercorrelations are then factor analyzed to find second-order factors. Similar procedures are followed for finding third-order factors, and so on.

In spite of the fact that I have always rotated orthogonally, I do not think that I have ever said that I believe only in orthogonal factors. As a matter of fact, I do believe that many factors *are* oblique; they are correlated nonzero. But I do not go further in trusting oblique rotations to give correct estimates of correlations between factors. I said earlier that simple structure is not a completely safe criterion for locating axes. The use of this criterion is especially critical in connection with oblique rotations. Typically, a very small number of loaded variables carry the load in determining where each axis should be located—perhaps two or three. This number is a very small sample out of a universe of such vectors. The universe can actually spread over quite a range of such vectors. As Eysenck and Eysenck (1969) pointed out, the omission of just a few variables from an analysis can make a great difference in the apparent degree of obliqueness in any part of an oblique solution.

I *am* willing to confess to a bias. I do like to find factors that are correlated as little as possible. This situation means less redundancy of meaning and a greater amount of information per factor. I should also like to know of evidence regarding factor intercorrelations, however, for this knowledge is one of the sources of information for developing conceptions of personality structure.

Factors at different levels. It is desirable to pursue further some features of different levels of generality. At this point, distinctions of levels have an important bearing upon the question of why analyses reach such different results. It seems not to be mentioned, but I am convinced that many of the discrepancies in rotational solutions can be traced to the fact that traits of different levels of generality come out on the same level in analysis. An examination of numerous factorial solutions is convincing of this conclusion.

Factorists seem to be reasonably well agreed as to how much generality there should be in first-order-level traits. But it is apparently not recognized when factors of different levels come out together at the same level in the analysis. Factors of only one level are traditionally expected. There seem to be cases in which even three levels of traits can be represented in the results of the same one-level analysis as if they belonged at the same level.

Some of these factors can represent traits actually below the usual first-order level. An example of this has appeared a number of times in the analysis of items from Scale M (Masculinity–Femininity) of the Guilford–Zimmerman Temperament Survey (GZTS) (Guilford & Zimmerman, 1949). One of the larger clusters of items in Scale M pertains to masculine versus feminine interests, vocational and avocational. Another cluster pertains to emotional sensitivity (sequeamishness, disgustfulness, etc.). Therefore, instead of a single M factor there are sometimes two (M_1 and M_2), separating along the lines of the two clusters. This event is more likely to happen when the tested subjects are all males or all females. Incidentally, this is one example that should lead analysts to consider what kinds of homogeneity they should have in populations of subjects. Homogeneities of certain kinds are essential for good experimental controls.

Sometimes the main cause of such an apparent "splitting" of a factor is the use of two or more variables that are much more like one another than like any other analyzed variables. An extreme case in analyzing inventory items as variables involves two questions that are essentially two forms of the same item. An example would be the following items: "Do you enjoy attending a lively party?" and "Can you let yourself go and have a good time at a lively party?" The outcome is likely to be a narrow factor, with unusually high loadings for those two items and much lower loadings for a very few others. Eysenck and Eysenck (1969) called such outcomes "tautological factors," or "T factors." Since there are other narrow factors not generated for the same reason, I refer to the whole group as subfactors. The appearance of subfactors may be facilitated by overextraction but is not to be invariably attributed to that circumstance.

Higher order factors can come out on the first-order level when the cleavages between first-order factors are not as marked as those for a higher order factor or factors. This kind of event may be assisted by underextraction, but that condition is not always sufficient reason. It could happen when one *set* of two or more first-order factors is orthogonal, or nearly so, to another set. The factors within the sets are correlated, but not necessarily very strongly so.

GUILFORD FACTORS

In comparing and relating the personality factors from different sources, I begin with the Guilford list and use it as a frame of reference.

Development

The history of these factors can be told quickly. The Guilford and Guilford (1934) report told of using Thurstone's earliest method of analysis and of finding four interpretable factors: (a) Social Introversion–Extraversion, (b) Emotional Sensitivity, (c) Impulsiveness, and (d) Interest in Self. The last-mentioned trait name was induced by the loadings for items emphasizing introspectiveness.

Guilford and Guilford (1936) soon applied Thurstone's new centroid method to the same data, which were intercorrelations of 36 questionnaire items answered by 930 students. The authors were still on the trail of hypothesized components of introversion–extraversion. From the 1936 analysis, three factor traits were rather clear: (a) Social Introversion–Extraversion (S), (b) Emotional Sensitivity (E), and (c) Masculinity–Feminity (M)—the latter with some emphasis on dominance or ascendance. Less clear were two additional factors: what later became known as Rhathymia (R), which included an impulsiveness aspect; and Meditative Thinking (T), which replaced Interest in Self.

The year 1939 saw two more analyses by the Guilfords (1939a, 1939b), using two partly new sets of items. Factors R, T, and S were confirmed, and a new one, D (Depression), which is relevant here, was discovered. It was proposed that D, S, and T were three dimensions of introversion–extraversion.

In the second of these two analyses (1939b), two additional new factors were found: Nervousness (N) and General Drive (G). Within the same period, Mosier (1937) had reported Factors I (Inferiority Feelings) and C (Cycloid Disposition) in analysis of items referring to neurotic symptoms. At this point, Guilford (1940) developed *An Inventory of Factors STDCR,* whose letter symbols stand for the traits under discussion.

In order to measure the other known factor traits, Guilford and Martin (1943a) published *The Guilford–Martin Inventory of Factors GAMIN* (Martin, 1945). *The Personnel Inventory* (Guilford & Martin, 1943b) quickly followed and was based upon an unpublished factor analysis of the items in the Paranoid scale of *The Humm–Wadsworth Temperament Scale* (Humm & Wadsworth, 1935), by J. P. Guilford and D. W. Dysinger. The three new factor traits were: Objectivity (O), Friendliness versus hostility (F), and Personal Relations, or cooperativeness (P). Thus, 13 traits were covered by scores from the three inventories.

The Guilford–Zimmerman Temperament Survey. In order to cover approximately the same range of traits within more reasonable time and effort, Guilford and Zimmerman (1949) developed a single instrument of 300 items, 30 for each trait. In earlier inventories, some strong correlations were found among Scales C, D, I, and N, which led to the decision to present one scale based upon items from these four sources. This reduced the number of scales to 10 and should have resulted in making the combined Scale E (Emotional Stability) represent a kind of second-order factor.

Because the GZTS traits are mentioned so often in what follows, their symbols, names, and brief definitions are listed in Table 1.

Construct Validity of Guilford Factors

Before presenting the model for the apparent hierarchical structure of the Guilford

TABLE 1

Description of the Traits of the Guilford–Zimmerman Temperament Survey

Symbol	Name[a] and Definition
G	General Activity vs. slowness and lacking in energy
R	Restraint and seriousness vs. rhathymia and impulsiveness
A	Ascendance and social boldness vs. submissiveness and timidity
S	Sociability and social interest vs. seclusiveness and shyness
E	Emotional Stability and optimism vs. instability and depression
O	Objectivity vs. subjectivity and hypersensitivity
F	Friendliness and agreeableness vs. hostility and belligerence
T	Thoughtfulness or reflectiveness vs. unreflectiveness
P	(Good) Personal Relations and cooperativeness vs. criticalness and intolerance
M	Masculinity of interests and emotions vs. femininity

Note. A *Handbook for the Guiliford-Zimmerman Temperament Survey* will soon be available. It will provide more intensive discussions on all matters regarding that instrument which are referred to here.

[a] Each name is represented by capital letters.

factor traits, some comments are made concerning the stability and replicability of those dimensions. The evidence comes from various sources; it is by no means confined to one laboratory.

To start within the same laboratory, however, it can be reported that Guilford and Zimmerman (1956) did a comprehensive analysis covering all 13 factors. Instead of analyzing single items as variables, they constructed homogeneous sets of items by content analysis. There were 69 such sets, and sex membership was added to make 70 variables. I recommend that in such analyses we get beyond the stage of analyzing single items as soon as possible. Comrey (1973) also recommended this approach, and he went further by making preliminary analyses of items to check on the homogeneity within each set, deriving what he called "FHIDs" (factored homogeneous item dimensions).

From the results of the analytical study just referred to, 13 of the factors nicely confirmed the Guilford factors. A 14th could be called Impulsiveness, but it was evidently a subfactor offshoot derived from a part of the items for Factor R (Restraint versus rhathymia). Impulsiveness items sometimes stay within the fold of R, but sometimes they do not.

From another laboratory, Bendig (1962b) confined an analysis to the scales of the GZTS. He formed three equal sets of 10 items each for each of the 10 scales' items. An oblique analysis of these 30 variables gave an almost perfect replication of the 10 factors, with the exception that a variable for Factor A went on Factor O instead.

From an analysis of Guilford items, Eysenck and Eysenck (1969) seemed to replicate eight of the Guilford factors, including G, R, S, F, T, C, D, and I. Factor N did not appear, but some of its items gave a subfactor of Sleeplessness. Two M subfactors were found, and they were called Compassion and Nervousness. The first was well named; the second involved items on reactions of disgust.

From an analysis of items in the Eysenck Personality Inventory, Eysenck and Eysenck (1969) reported nine factors that seem to correspond with Guilford factors: G, R, A, S, F, T, C, D, and I—about as many as could be expected. In such identifications, I have relied on the authors' own naming as well as on knowledge of where such items are usually loaded in analyses. It should be said that I have not reported all analyses of Guilford items. Some are less favorable.

In analyzing Cattell's items, Howarth and Browne (1971b) found factors that could be identified as R, S, E, P, and M. With a sample of more than 2,000 U.S. Air Force airmen, Sells, Demaree, and Will (1970, 1971) analyzed in a very impressive study (as far as numbers are concerned) 600 items drawn equally from Cattell and Guilford inventories. Of the Guilford factors, G, R, S, E, F, and P could be identified. There were also two subfactors, T_1 and T_2, which the authors identified as "Meditative Thinking" and "Critical Thinking"; and two more subfactors, M_1 and M_2, with the usual distinction between sex-related interests and emotional sensitivity. Their Factor E was based upon items for Factors C, D, and N, which makes it a second-order factor. In this analysis we have a good example of three levels of factors coming out together.

The most convincing evidence of validity for the Guilford factors is to be found in a review by French (1973). He studied all available analyses of personality items to derive a list of "established" factors. His criterion was that the established factor had to have appeared in at least three analyses in at least two laboratories. Of the 13 Guilford factors of concern here, 11 satisfied the criterion. Factor C was lost in what I have considered to be a second-order factor, E; and F did not correspond well with French's factor Agreeableness.

A Model for 13 Guilford Factor Traits of Personality

Correlations of first-order factors. A hierarchical model for traits is justified on the basis of nonzero correlations between factors at each level. The evidence that I have used most in deriving a correlational structure for the 13 Guilford factors has come from intercorrelations of total scores from the scales for those factors. It must be admitted that such correlations are rough estimates, for the scale score vectors cannot be assumed to coincide with the factor trait vectors; they are only approximations. Nevertheless, they show considerable consistency regarding a correlational picture. In the GZTS, at least, each scale is immaculate in the sense that no item is scored for more than one trait.

Two analyses were done with all 13 score variables (Lovell, 1945; Thurstone, 1951). More than 20 analyses were found in the literature, which used the 10 GTZS scores either alone or with scores from other instruments of personality measurement. Where the other instruments do not have factor scores, the latter procedure is not to be recommended because their scores are likely to be factorially complex, hence poor material for analysis. Useful information regarding the GZTS scale scores were forthcoming from all these sources, however.

As far as the GZTS scores were concerned, the typical result gave three factors. One was based upon first-order scores for S and A, sometimes with a significant loading for G. The second was based upon scales R and T. There were some inconsistencies in findings with regard to the remaining scales, except that Scale M usually remained apart from any higher order factor. When there was only a third second-order factor, it embraced E, O, F, and P. This outcome occurred most often. When there was a fourth factor, the clustering was of E with O on one factor and O, F, and P on the other.

For those investigators who prefer to reach higher order factors from oblique rotations, there is confirming evidence from Bendig's (1962b) analysis of the 30 subscales he formed from the GZTS, as mentioned earlier. His groupings of factors were SA, RT, EO, and OFP. Thus, in this case at least, the two approaches to determining higher order factors agree well.

As for finding any third-order factors, we lack information regarding correlations among the second-order factors. But there is other evidence that we can use. The fact that factors EO and OFP have one variable in common ensures correlation between the two. The scale for E also shows some significant correlations with F and P, as well as with O. We may therefore assume that the third-order factor EOFP exists. Supporting evidence is the fact that, as indicated earlier, a broader factor of just this kind often came out in analyzing total scores of the GZTS. We have already seen that two or more levels of factors can come out in the same analysis.

There seems to be no basis whatever for a third-order factor that embraces factors SA and RT, since correlations of members of the one pair with those of the other pair are zero or near zero. This fact has an important bearing on Eysenck's Factor E, soon to be discussed.

The model of 13 factors. Putting all these findings together, the model in Figure 1 has been designed. The 13 first-order factors are laid out in a row, ordered to take account of the higher order factors. Although not entering into any cluster, M is shown, alone, in order to be included. Groups of first-order factors are shown connected by lines with their second-order factors. The dotted line for G indicates its weaker connection. The second-order factor SA has been interpreted as Social Activity, the *activity* part of the label indicating the contribution of G.

The factor for R and T is called Introversion–Extraversion, but it should by no means be identified with Eysenck's E (Extraversion–Introversion), for reasons soon to be explained. It was stated before that Factor E of the GZTS is at the second level and depends upon the first-order factors C, D, N, I, and O. The factor connected with O, F, and P has been identified as Paranoid (or freedom from paranoid disposition), since those three factors were found in the Humm–Wadsworth scale.

The third-order factor, which embraces E and Pa, has been given the very general label of Emotional Health (EH). This title was suggested in part by the realization that items in this broad category imply self-evaluation. The examinee feels generally all right or generally not all right, or something in between, which may have effects on his or her answering questions in all these categories. Such a broad generalization is sufficient to generate a very broad factor. The biasing of responses that is apparently most common in this area probably also contributes to a broad factor.

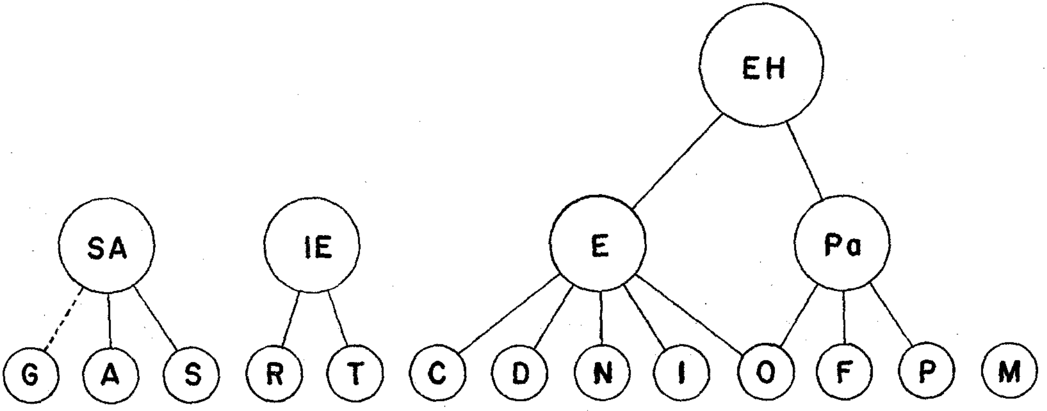

FIGURE 1. A proposed hierarchical model for some of Guilford's factors of personality, showing four second-order factors: SA (Social Activity), IE (Introversion–Extraversion), E (Emotional Stability), and Pa (Paranoid disposition); also a third-order factor, EH (Emotional Health).

Eysenck's Factors E and N

Eysenck (1959) has long championed two factor traits that he regards as covering what is most important in personality: E (Extraversion–Introversion) and N (Neuroticism). The development of his scales started with items of the Guilford inventories. In the Maudsley Personality Inventory, there are items that pertain to certain Guilford factors in the following numbers: For Scale E there are 12 R items, 10 S items, 1 A, and 1 G, as judged from extensive information as to where the items go in analyses. For Scale N, there are 7 D items, 6 N items, 2 C, 2 I, 2 O, and 1 E. He has added other items in the later Eysenck Personality Inventory (Eysenck, 1964), but all remain within the same categories and in approximately the same proportions. It is not surprising then that when his items are analyzed, they yield Factors R, S, D, N, and I.

Eysenck stated that both his factors are at the third level (Eysenck & Eysenck, 1969), but I have to disagree. In reference to the model in Figure 1, it seems clear that his Factor N is almost identical to the second-order factor E because they have D, C, I, and N in common, with his N having little contribution from O. His N has nothing from F and P, which would be needed to put it at the third level.

As for his Factor E, I am forced to conclude that it is not a factor at all, but a kind of "shotgun wedding" of R and S. It should be noted that the average of a number of samples of correlations of R with S is actually .11 for men and .23 for women (when R is scored for Rhathymia at the high end, as Eysenck would have it). On the other hand, R correlates with T with an average of .37 for men and .31 for women. Average correlations between S and A are .64 and .58 for men and women, respectively. To complete the picture, the average correlations between R and A are .00 and −.07. All these correlations account for the pairings of SA and RT, in disagreement with the affiliation forced by Eysenck.

Eysenck himself has reported a number of zero correlations between items loaded on S and some loaded on R (Eysenck & Eysenck, 1969). He offered as "proof" that his E is a unitary trait the fact that his score for E correlates zero with his score for his N. What he actually has is a correlation between one set of first-order factors, R and S, and a set included within his N (Guilford's DCIN), two sets that are orthogonal, or nearly so.

The lack of cohesiveness of Eysenck's E has been noted by others (Bendig, 1962a; Howarth & Browne, 1972). This situation is serious because there have been so many studies using the score for Eysenck's E as a variable. When positive results are obtained in such experiments, the ambiguity of the E score leaves us with the feeling of uncertainty as to whether to attribute the effects to differences in R or in S, or in both.

CATTELL'S PERSONALITY FACTORS

Development

In his extensive research on personality factors, Cattell (1945) started with a fresh approach. Although he was aware of previous findings, he more or less ignored them in planning his own campaign. Whereas Guilford had started in the limited area of introversion–extraversion and expanded explorations from there, Cattell thought a better strategy was to begin with what he called the "whole personality sphere."

This universe was pictured at first in terms of some 17,000 trait names. From this list, Cattell selected 4,505 that he considered to be "real." Synonyms were then grouped under "key" concepts, which yielded 160 categories. This number was reduced still further, using some correlational information, to form clusters. His descriptions of the clusters suggest their psychological complexity. For example, four of them read: evasive, autistic, egoistic; infantile, hostile; active, unstable; and sensitive, hurried, withdrawn. It would seem that, logically, the members of every set just mentioned could be independent traits. To put them together in order to score persons might therefore forestall the discovery of distinctions between traits. Cattell (1946) admitted that "each cluster itself has at least two dimensions" (p. 295).

The clusters were reduced to 60 and then to 35, the latter to furnish the variables to be analyzed. Along the way, categories and clusters were dropped. Cattell (1945) admitted that some of the personality sphere might have been lost.

The factor analysis used ratings on the 35 clusters as the variables to be analyzed. Two raters ranked 16 men in each of a number of groups. The analysis gave 12 factors, only 8 of which had more than one variable loaded significantly ($\geq .30$). With this criterion, which has been the prevailing one, 4 factors would be regarded as singlets. Loadings as low as .16, however, were used in the interpretation of factors.

On the whole the results were far from decisive, in view of the mathematical information. Also, the use of ratings in factor analysis is highly questionable, for the results may tell us as much about conception of traits on the part of the raters as about personality dimensions—a study in semantics as well as psychology.

The same factors were later reported to be found in analyzing questionnaire data, and four factors from that source alone were added to make Cattell's traditional 16. The same 16 have persisted in much the same form over the years. Using the same items with the same kind of subjects and with similar methods, replications could be expected.

Other Difficulties with Cattell's Analyses

Additional difficulties can be cited. His initial effort to analyze the entire personality sphere in one fell swoop is very unrealistic. There are undoubtedly more personality factors than Cattel had clusters or variables—an impossible situation for analysis. He was undoubtedly expecting a small number of dimensions, whereas there are actually a great many. My own survey of the factors of personality (Guilford, 1959) provides a list that numbers 58. Of these, 18 are considered to be in the area of temperament; 35 are in the area of motivational, or "hormetic," traits—interests and need traits; and 5 are dimensions of attitudes. If one wished to be more conservative, he could take French's (1973) "established" factors as an outside estimate. French's number reached 28. Even this number could not be accounted for in an analysis with only 35 variables.

The use of complex variables in Cattell's analyses should be expected to lead to complex factor dimensions, and this effect can be noted in the naming and defining of his factor traits. For example, his Factor C is described as Character or Superego Strength versus lack of rigid, internal standards. That much would seem univocal, but he added the following: conscientious, persistent versus casual, undependable—within which is much room for serious distinctions. His Factor L is described as Protension versus relaxed security. He gave *paranoid trend* as a synonym for *protension*. *Paranoid trend* reasonably includes *suspecting*, but does it also include *jealousy*, which he also gave as a description? And is *relaxed security* on the same dimension as *paranoid trend?* Such locutions suggest an effort to cover and integrate the implications of items that are loaded together on the same factor when they point logically in diverse directions. We should aim at psychological simple structure as well as mathematical simple structure. Psychological simple structure calls for simple constructs, not complex ones.

Another major question pertains to Cattell's extensive use of items of notoriously low intercorrelations to represent the same factor and to serve in measuring it, as Levonian (1961) pointed out some years ago. From intercorrelations of Cattell's items, Levonian concluded that 40% of the correlations between items for *different* factors were statistically significant at the .01 level. Of 1,612 significant correlations, only 183 were between items for the *same* factors, and 10 of these were in directions opposite those to be expected. Cattell (1972) rationalized this situation by saying that he used some items to serve as suppressor variables, but to my knowledge he has never revealed which items are suppressing what unwanted variances.

Validity of Cattell's Factors

What have others found in analyzing Cattell's items? There have been a number of relevant analyses. Gibbons (1966) analyzed Cattell and Guilford items together in small, homogeneous sets or subscales. There were 40 such variables for Cattell's 15 factors (omitting his Factor B, called Intelligence) and 28 for Guilford's 15 factors—adding AA (Aesthetic Appreciation) and CC (Cultural Conformity), believing that these two factors are represented in a number of Cattell's items.

The analysis, with orthogonal, graphic rotations, was said to identify 15 factors. Of these, 8 were Guilford factors only, 4 were Cattell factors only, and 3 were in common to the two sources. The Guilford-only factors were G, R, A, T, I, N, D, and AA. The Cattell-only factors were F (Surgency versus desurgency), L (Protension versus relaxed security), Q_2 (Self-Sufficiency versus group dependency), and Q_4 (High Ergic Tension versus low ergic tension). Two factors more clearly in common were S with Cattell's H (Parmia versus threctia), and M with his I (Premsia versus harria). Cattell's C (Emotional Stability versus dissatisfied emotionality) resembles Guilford's E, two of whose variables went with it, but others went to supply the first-order factors I, N, and D, as stated. Thus, the overlap in terms of one-to-one dimensions for the two sets of factors was very limited.

Subsequent to Gibbon's analysis, Cattell reanalyzed the same correlations in his own way. As a result, Guilford's factors largely vanished, and more Cattell factors appeared (Cattell & Gibbons, 1968); apparently 13 Cattell factors and 5 Guilford factors, 3 being in common.

More recently, Howarth and Browne (1971a) analyzed together selected items from the three inventories, of Cattell, Eysenck, and Guilford. Items were selected because of their higher loadings on factors found earlier by Sells, Demaree, and Will (1970, 1971). Of the 15 factors rotated, 8 could be identified as Guilford factors, 2 as Cattell factors, and 4 as subfactors. The Cattell factors were apparently his G (Superego Strength) and D (Excitability).

Again, the most convincing evidence on construct validity of factors can be found by reference to French (1973). Of the 28 established factors in French's list, four are aligned with Cattell's factors. They are C (Emotional Stability), D (Excitability), F (Surgency versus Desurgency), and Q_3 (High Self-sentiment Formation versus poor self-sentiment formation). Thus, Cattell's factors are not well replicated outside his own laboratory.

THE COMREY PERSONALITY INVENTORY

Probably Comrey's (1970) Personality Inventory and his factors have not been around long enough to figure very much in the general confusion of tongues. But his inventory is also based upon factor traits, so that it should be considered here in relation to all the others. Comrey's general strategy was to analyze the items in each of the scales of the Minnesota Multiphasic Personality Inventory. He would thus be likely to bring into the factorial picture some new dimensions, which was the case, while accounting also for some of the older ones.

Along the way, he found three factors that seemed to align with Guilford traits. One that he called Cynicism or Trust versus Defensiveness, can be aligned with P, whose main positive characteristic is tolerance. His Emotional Stability is like E, but I am not sure that he would agree that it is a second-order factor. He found factors like M and G. Three factors are very similar to those found by Holley (1951). One that Comrey called Orderliness and Compulsion is like Holley's Meticulousness. A Social Conformity versus Rebelliousness resembles Holley's Need for Discipline. Comrey's Empathy can be equated with Holley's Benevolence. These three factors are represented in the Guilford–Holley L Inventory (Guilford & Holley, 1953).

In a recent analysis (Comrey, Jamison, & King, 1968), items of the Comrey Personality Inventory and the GZTS were treated together, using homogeneous item sets as variables. Of the 10 factors identified, 3 were exclusively Guilford factors—G, T, and M; 2 were exclusively Comrey factors—Empathy and Compulsion. The other 5 were apparently in common to the two sources. Comrey's Shyness seems to be aligned with both S and A of the GZTS, which suggests that it is the second-order factor SA. A factor that he called Dependence went predominantly with items for S but not for A. His Neuroticism seems like the E of the GZTS and may thus be a second-order factor. Hostility is reasonably the opposite of F of the GZTS. His Socialization factor seems like his earlier Cynicism and is probably aligned with the Guilford–Zimmerman Factor P.

In Comrey's investigations, there seems to have been little (except his Emotional Stability, which almost everybody finds) to support either the Eysenck or Cattell factors.

DISCUSSION

In an effort to reconcile divergent and conflicting results from differeent factor analyses, I have employed in many instances the alleged principle that factors of more than one level of psychological generality can come out in the same analysis on one level. This principle needs justification and some guidance on how to deal with it, and it has some implications for personality theory.

The observing, experienced factor analyst must surely have noticed the phenomenon of the splitting of factors and also that of the confounding of factors. In the first case, a factor that is represented by a larger list of loaded representatives in one analysis is replaced by two factors, with the loaded set of variables separating. In the second case, the reverse change occurs. What were formerly two narrower factors come together as one. Referring to earlier examples, we saw that sometimes there is one M (Masculinity) factor and sometimes two. Sometimes a subfactor of Impulsiveness splits off from the rest of R (Rhathymia), and a subfactor of Sleeplessness leaves factor N (Nervousness).

How Factor Levels Can Be Detected

These phenomena raise the question of how we can identify the order or level of an obtained factor. No mathematical procedures have been developed to meet this particular need, and perhaps none can be found. The best that we can do at this time is to set up some rough guidelines for reaching decisions in an intuitive manner.

I said earlier that analysts seem to agree fairly well as to what kinds of factors belong at the first-order level. I have to add that they do not as readily recognize when subfactors or second-order factors occur. From a single analysis, as in an exploratory study, there is little basis for decisions as to levels. The only usable clue is the apparent generality of the psychlogical trait in question. Sometimes the clue is the fact that loaded on the same factor are variables with divergent meanings, perhaps with two or more meaningful clusters. This event should suggest a higher order factor.

With growing experience, observations of splittings and of confoundings should furnish fairly good evidence, especially if such events are replicated. Experiences from solutions with oblique rotations in one analysis should provide evidence that can be used in future analyses. One would need to be sure, however, that the first-order factors obtained are actually at the same level.

Probably the easiest to identify are factors at the subfactor level, particularly what Eysenck called "T factors." In the analysis of questionnaire items, a T factor typically has two items with extra-large loadings, for their intercorrelation is actually a reliability coefficient. Loadings near .70 are common in such instances.

How to Avoid Variations in Factor Levels

The most general remedy for avoiding more than one level of factors emerging in a one-level analysis lies in the selection of the variables to be analyzed. Attention needs to be given to the probable scope or degree of generality of the factors to be expected and to the variables to be used. This involves the investigator in hypothesis formation as to the nature of his variables and his expected factors (something that he should do for other reasons as well), for he cannot decide the question of scope without considering the nature of the dimensions involved. The avoidance of T factors, and other subfactors, should not be very difficult. One need only make sure that two or more variables are not so highly similar that they are probably nearly identical. The extraction of an appropriate number of factors should help but would probably not ensure success.

Distinctness of Factor Levels

The phenomenon of factors jumping levels suggests that we should give more attention to the generality of traits. We might then conclude that the levels are not quite as distinct and as stable as factor theory would imply. Elsewhere (Guilford, 1959) I have theorized that the same trait is not equally generalized, or generalized in just the same way, in all individuals. This principle of individuality is ordinarily not taken into account by factor analysts, but it is at least implicitly recognized by other kinds of analysts. It should also be remembered that the degree of generality that we find for a trait by factor analysis is a feature of the average person in the group, not necessarily a description of how any one person's traits are organized. This principle also complicates the picture, but in understanding individuals one must deal with it.

REFERENCES

Bendig, A. W. Factor analysis of the Guilford–Zimmerman Temperament Survey and the Maudsley Personality Inventory. *Journal of General Psychology,* 1962, *67,* 21–26. (a)

Bendig, A. W. The factorial validity of the Guilford–Zimmerman Temperament Survey. *Journal of General Psychology,* 1962, *67,* 309–317. (b)

Cattell, R. B. The description of personality: Principles and findings in a factor analysis. *American Journal of Psychology,* 1945, *58,* 60–90.

Cattell, R. B. *Description and measurement of personality.* New York: World Book, 1946.

Cattell, R. B. The 16PF and basic personality structure: A reply to Eysenck. *Journal of Behavioral Science,* 1972, *1,* 169–187.

Cattell, R. B., & Gibbons, B. D. Personality factor structure of the combined Guilford and Cattell personality questionnaires. *Journal of Personality and Social Psychology,* 1968, *9,* 107–120.

Comrey, A. L. *Manual for the Comrey personality scales.* San Diego: Educational and Industrial Testing Service, 1970.

Comrey, A. L. *A first course in factor analysis.* New York: Academic Press, 1973.

Comrey, A. L., Jamison, L., & King, N. Integration of two personality factor systems. *Multivariate Behavioral Research,* 1968, *3,* 147–159.

Eysenck, H. J. *Manual for the Maudsley Personality Inventory.* London: University of London Press, 1959.

Eysenck, H. J. *Manual of the Eysenck Personality Inventory.* London: University of London Press, 1964.

Eysenck, H. J., & Eysenck, S. B. G. *Personality structure and measurement.* San Diego: Robert R. Knapp, 1969.

French, J. W. *Toward the establishment of noncognitive factors through literature search and interpretation.* Princeton, N.J.: Educational Testing Service, 1973.

Gibbons, B. D. *A study of the relationships between factors found in Cattell's 16PF Questionnaire and factors found in the Guilford personality inventories.* Unpublished doctoral dissertation, University of Southern California, 1966.

Guilford, J. P. *Manual for an inventory of factors STDCR.* Beverly Hills, Calif.: Sheridan Supply, 1940.

Guilford, J. P. *Personality.* New York: McGraw-Hill, 1959.

Guilford, J. P., & Braly, K. W. Extroversion and introversion. *Psychological Bulletin,* 1930, *27,* 96–107.

Guilford, J. P., & Guilford, R. B. An analysis of the factors in a typical test of introversion–extroversion. *Journal of Abnormal and Social Psychology,* 1934, *28,* 377–399.

Guilford, J. P., & Guilford, R. B. Personality factors S, E, and M and their measurement. *Journal of Personality,* 1936, *2,* 109–127.

Guilford, J. P., & Guilford, R. B. Personality factors D, R, T, and A. *Journal of Abnormal and Social Psychology,* 1939, *34,* 21–36. (a)

Guilford, J. P., & Guilford, R. B. Personality factors N and GD. *Journal of Abnormal and Social Psychology,* 1939, *34,* 239–248. (b)

Guilford, J. P., & Holley, J. W. *The Guilford–Holley L Inventory.* Beverly Hills, Calif.: Sheridan Supply, 1953.

Guilford, J. P., & Martin, H. G. *The Guilford–Martin Inventory of Factors GAMIN.* Beverly Hills, Calif.: Sheridan Supply, 1943 (a)

Guilford, J. P., & Martin, H. G. *The personnel inventory.* Beverly Hills, Calif.: Sheridan Supply, 1943. (b)

Guilford, J. P., & Zimmerman, W. S. *The Guilford–Zimmerman Temperament Survey: Manual.* Beverly Hills, Calif.: Sheridan Supply, 1949.

Guilford, J. P., & Zimmerman, W. S. Fourteen dimensions of temperament. *Psychological Monographs,* 1956, *70,*(10, Whole No. 417).

Holley, J. W. *The isolation of personality traits in the domain of military leadership.* Unpublished doctoral dissertation, University of Southern California, 1951.

Howarth, E., & Browne, J. A. Investigation of personality factors in a Canadian context: I. Marker structure in personality questionnaire items. *Canadian Journal of Behavioral Science,* 1971, *3,* 161–173. (a)

Howarth, E., & Browne, J. A. An item analysis of Cattell's 16PF. *Personality,* 1971, *2,* 117–139. (b)

Howarth, E., & Browne, J. A. An item factor analysis of the Eysenck Personality Inventory. *British Journal of Social and Clinical Psychology,* 1972, *11,* 162–174.

Humm, D. G., & Wadsworth, G. W. The Humm–Wadsworth Temperament Scale. *American Journal of Psychiatry,* 1935, *92,* 163–200.

Jernigan, L. R., & Demaree, R. G. Item-factor analysis of the Guilford–Zimmerman Temperament Survey. *Proceedings of the 79th Annual Convention of the American Psychological Association,* 1971, *6,* 111–112. (Summary)

Levonian, E. A statistical analysis of the 16 Personality Factors Questionnaire. *Educational and Psychological Measurement,* 1961, *21,* 589–596.

Lovell, C. D. A study of factor structure of thirteen personality variables. *Educational and Psychological Measurement,* 1945, *5,* 335–350.

Martin, H. G. The construction of the Guilford–Martin Inventory of Factors G-A-M-I-N. *Journal of Applied Psychology,* 1945, *29,* 298–300.

Mosier, C. I. A factor analysis of certain neurotic tendencies. *Psychometrika,* 1937, *2,* 263–287.

Sells, S. B., Demaree, R. G., & Will, D. P. Dimensions of personality: I. Conjoint factor structure of Guilford and Cattell trait markers. *Multivariate Behavioral Research,* 1970, *5,* 391–422.

Sells, S. B., Demaree, R. G., & Will, D. P. Dimensions of personality: II. Separate factor structures in Guilford and Cattell trait markers. *Multivariate Behavioral Research,* 1971, *6,* 136–165.

Thurstone, L. L. The dimensions of temperament. *Psychometrika,* 1951, *16,* 11–20.

(Received October 9, 1974)